Using Six Sigma to Improve Systems Engineering

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What is Six Sigma?

- **Six Sigma is a management philosophy based on meeting business objectives by striving for perfection**
  - A disciplined, data-driven methodology for decision making and process improvement
- **Six Sigma consists of several integrated methods:**
  - Process Management
  - Voice of the Customer
  - Change Management
  - Tools for Measuring Variation and Change
  - Business Metrics
- **The focus is on understanding and reducing variation**

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DMAIC Steps

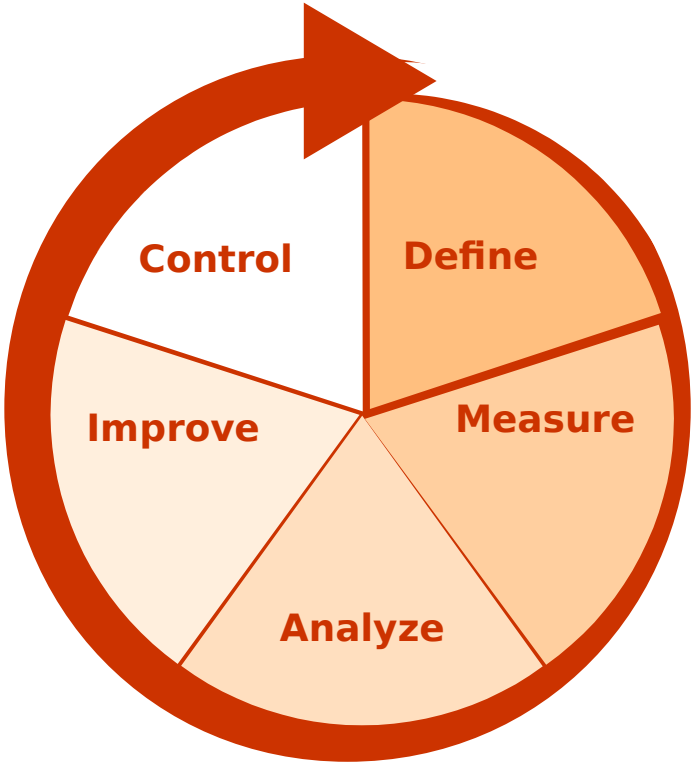
DEFINE
Set project goals and objectives

MEASURE
Narrow range of potential causes and establish baseline capability level

ANALYZE
Evaluate data/information for trends, patterns, causal relationships and "root causes"

IMPROVE
Develop, implement and evaluate solutions targeted at identified root causes

CONTROL
Make sure problem stays fixed and new methods can be further improved over time



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Applying Six Sigma to Systems Engineering

- **Software and system processes are fuzzy**
  - Production of software or systems engineering "parts" is less predictable than manufacturing of physical parts
  - Greater variation in human cognitive processes can prevent rigorous application of the Six Sigma methodology
  - Process variation can never be eliminated and may not even reduced below a moderate level
- **Results often cannot be measured in clear $ savings returned to organization**
  - Benefits are reduced risk, increased customer satisfaction, more competitive bids, …

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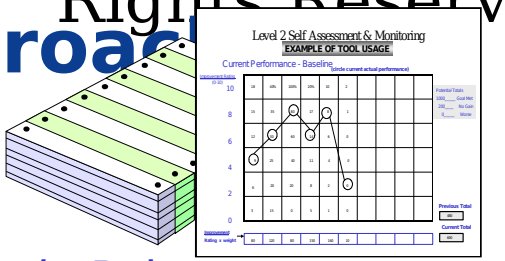
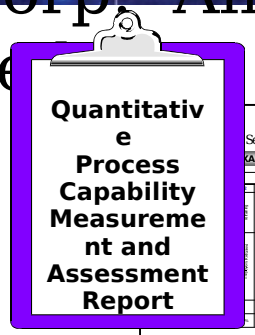
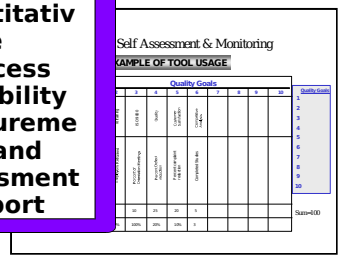
Our Six Sigma Approach







Quantitatively Driven

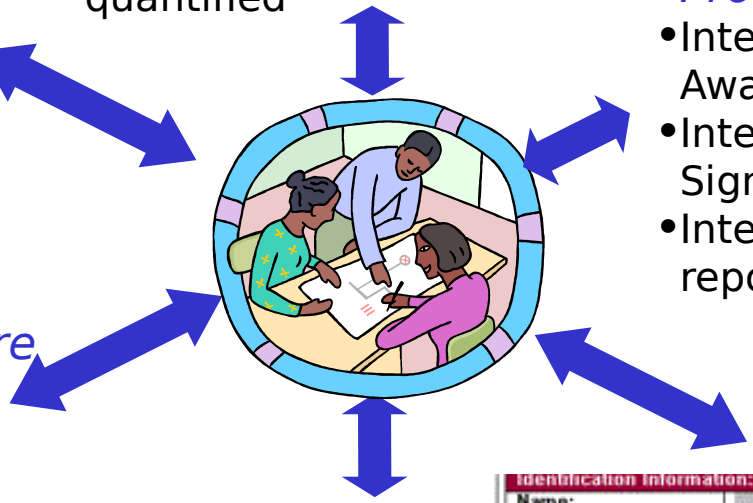
- Six Sigma improvements are quantified

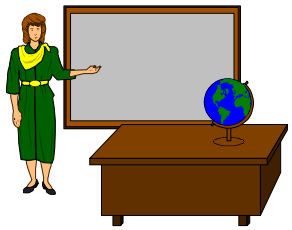
Linked with Business Planning and Oversight

- Business planning
- Project selection

Integrated with Quality Program

- Integrated Training, Awareness, & Policies
- Integrated CMMI & Six Sigma projects
- Integrated tracking and reporting via DB, PRA, etc.





Enabled by Infrastructure

- Training
- Tools
- Awareness
- Database

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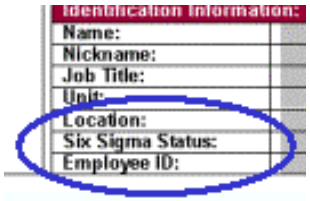
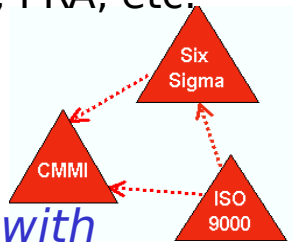
Tied to Employee Performance

- Goals, awards
- Job and career paths



Engaged with External Customers

- Visibility
- Participation



Startit! – a NGMS product

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Six Sigma Implementation

- **Starting implementing Six Sigma in 2001**
- **Trained over 3000 Green Belts (80 hours), and over 200 Black Belts (160 hours)**
- **Completed several hundred projects covering all functional areas**
  - Customer involvement and award fee citations
- **About half of the projects are improving an engineering process**

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Level	Focus	Process Areas
5 Optimizing	*Continuous process improvement*	Causal Analysis and Resolution Organizational Innovation and Deploym
4 Quantitatively Managed	*Quantitative management*	Quantitative Project Management Organizational Process Performance
3 Defined	*Process standardization*	Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Risk Management Decision Analysis and Resolution Requirements Development Technical Solution Product Integration Verification Validation
2 Managed	*Basic project management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Performed		

Capability Maturity Model Integrated

Level 5
Focus is on preventing defects and innovation (addressing common causes of variation)

Level 4
Focus is on understanding and managing special causes of variation, at both the project and organizational levels

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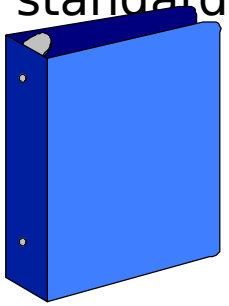
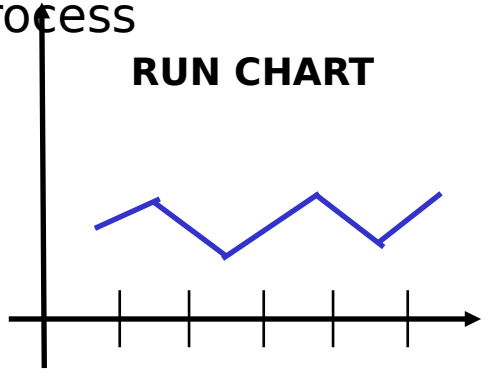
Maturity Level 4

Understanding and managing special causes of variation

Organization

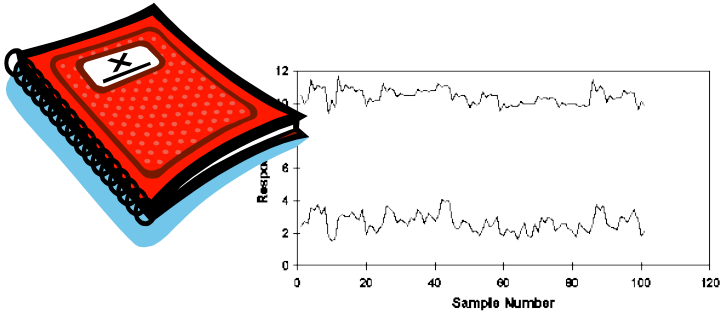
- Establishes organizational goals
- Establishes standard process
- Characterizes process performance and quality of the standard process





Project

- Establishes project goals
- Tailors standard organizational process to create project's defined process
- Selects critical subprocesses to quantitatively manage



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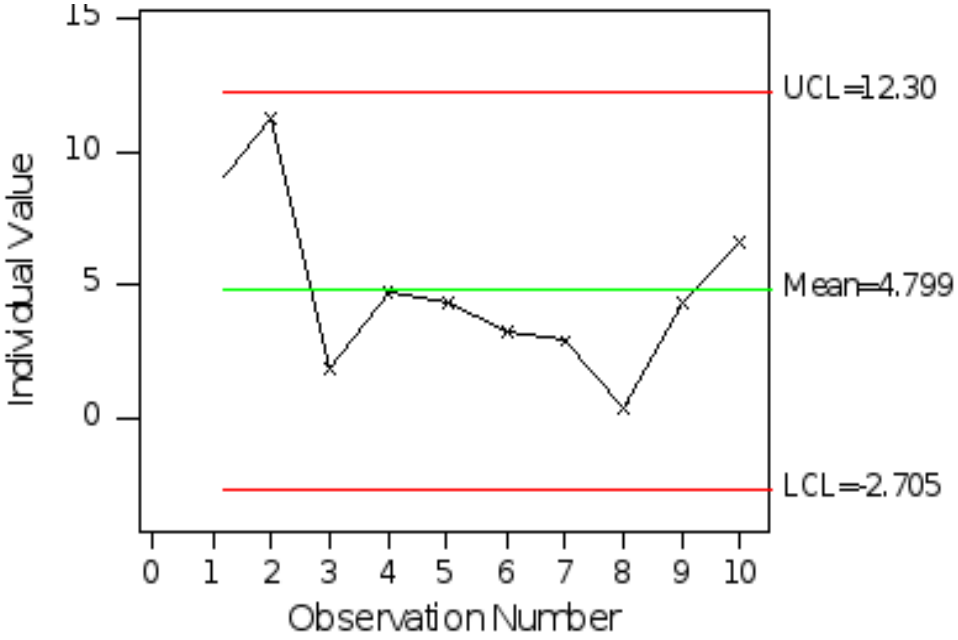
Quantitative Management Example (not real data)

Peer Reviews – Understanding the Process

- **How many errors does the team typically find in reviewing an interface specification?**
- **Useful in evaluating future reviews**
  - Was the review effective?
  - Was the process different?
  - Is the product different?



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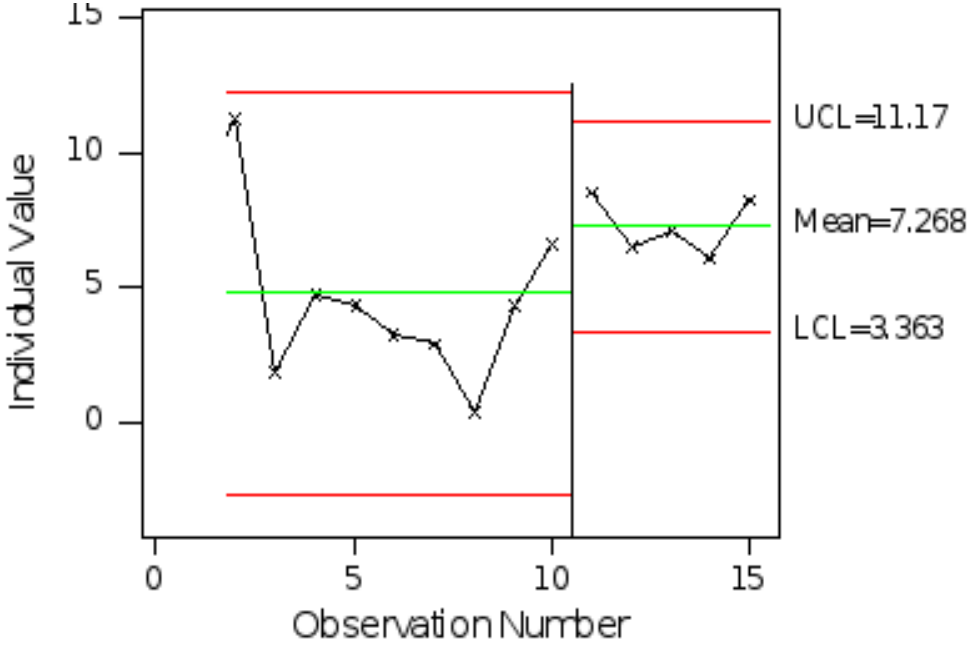
Quantitative Management Example (not real data)

Peer Reviews – Improving the Process

- **Reduce the variation**
  - Train people on the process
  - Create procedures/checklists
  - Strengthen process audits
- **Increase the effectiveness (increase the mean)**
  - Train people
  - Create checklists
  - Reduce waste and re-work
  - Replicate best practices from other projects



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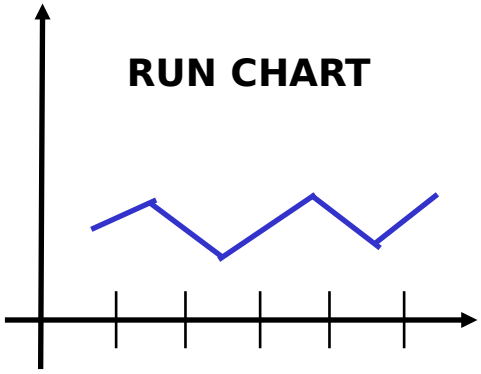
Maturity Level 5

Preventing defects and innovation (addressing common causes o

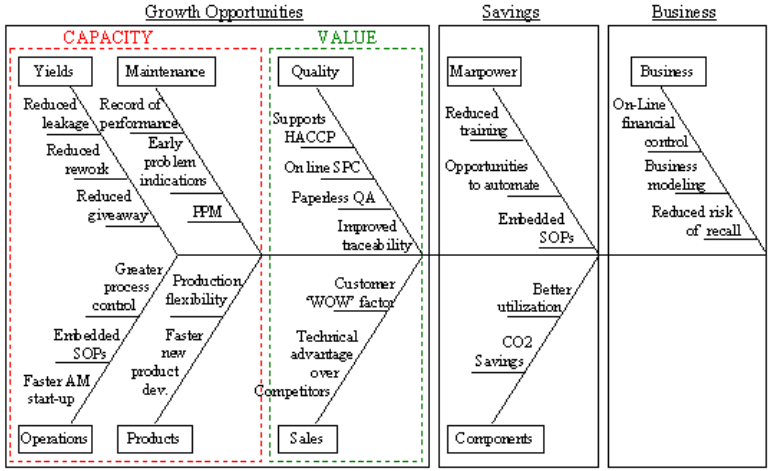
Organization

- Identifies incremental and innovative improvements
- Pilots improvements
- Deploys and measures (quantitatively) the results



Project

- Identifies causes of defects and other problems
- Takes actions to prevent them from occurring in the future



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Results

- **Organizational-wide adoption and training has resulted in a workforce that understands varia**
  - Common language
  - Common toolset
  - Common focus on reducing variation
- **Results have been seen in our rapid achievement of CMMI Levels 4 and 5**
  - Transition from Level 3 to 5 typically takes about 18 months
  - Our organizations have been transitioning in 9 months!